WORKING WITH
LOCKHEED MARTIN, IAI
IS USING FUZZY CMAC
TECHNOLOGY TO DEVELOP
A SYSTEM THAT CANCELS
MACHINE VIBRATIONS.

HYBRID COMPUTER TO SIMPLIFY CONTROL SYSTEM DESIGN

Design difficulties limit the use of neural networks for real-time control. For example, designers require complex models to account for many system variables. Furthermore, these variables change constantly, testing the neural network's limited ability to adapt to changing conditions.

To solve this problem, Intelligent Automation, Inc. (IAI; Rockville, MD), is developing the Fuzzy Cerebellar Model Arithmetic Computer (CMAC) with funding from BMDO's SBIR program. IAI's technology will learn ten times faster than conventional neural networks. It could simplify the design of real-time control systems and improve the speed and precision of pattern recognition systems.

Using its Fuzzy CMAC technology, IAI is working with Lockheed Martin to build a system that cancels machine vibrations, enabling machine tools to cut faster and more accurately. It is also developing a scanning-probe microscope that learns the characteristics of the sample as its scans, allowing faster and more accurate images. In a test, Fuzzy CMAC detected abnormal traffic patterns on a highway with 99 percent accuracy. Fuzzy CMAC has also tested successfully as a nonlinear adaptive signal filter.

Applying its innovative technology to law enforcement, IAI will use Fuzzy CMAC to further automate RotoScan™, a patented device for analyzing scratches (or striations) on a bullet, also known as ballistics testing. Useful as evidence in court, these scratches are the "fingerprint" of a particular gun on a spent bullet. A computer stores the bullet images on a disk, enabling investigators to identify and match the bullets. IAI and Mnemonic Systems, Inc., experts in forensic technology, are currently building RotoScan devices for law enforcement agencies.

Another potential application for Fuzzy CMAC is in flight control systems. For example, the ability to predict maneuverability and to accommodate uncertainties makes flight control systems more reliable and adaptive. When pilots input certain control parameters, they expect the aircraft to respond accordingly. But a full or near-empty gas tank may cause the response to differ from their expectations. IAI's technology could adjust for this difference in real time. In another application, Fuzzy CMAC could help weapons systems lock on to targets quickly and accurately.

■ RotoScan™, pictured above, is a ballistics testing device whose automation may be enhanced with IAI's Fuzzy CMAC technology.

ABOUT THE TECHNOLOGY

Fuzzy CMAC combines the ease of coding and the flexibility of fuzzy logic controllers with the self-learning ability of neural networks. These technologies enable the system to learn and to generate output faster than other learning control mechanisms. IAI expects Fuzzy CMAC to be easier to install in system hardware than conventional neural networks. For example, one test verified the possibility of easy and affordable customization of the device as a multiple-digital signal processor for an active-vibration isolation system, executing operations at close to a gigaflop rate.